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The FOREST MANAGEMENT Newsletter

Issue 4 • Winter/Spring 1999

Communicating Issues and Ideas Important to the Management of Montana's State Forest Lands

Managing for Biodiversity

Tom Schultz

Management Philosophy

When the Department of Natural Resources and Conservation (DNRC) adopted the State Forest Land Management Plan (SFLMP) in 1996, we stated, "The best way to produce long-term income for the trust is to manage intensively for healthy and biologically diverse forests." *Biodiversity* is defined as "the variety of life and its processes." It includes the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur (Keystone Center 1991). This strategy was based on the belief that biologically diverse forests would provide sustained income in the face of uncertainty regarding future resource values. Another rationale for adopting a biodiversity management strategy was that we assumed management risk could be reduced, much as financial planners diversify their portfolios to reduce risk.

Coarse Filter

In order to meet our biodiversity standards, we have used a *coarse filter* approach that relies on managing for an appropriate mix of stand structures and compositions on state land. By managing for these appropriate conditions, we feel that our approach will support diverse vegetative communities and wildlife habitat. The coarse filter approach has been recently endorsed by the federally appointed Committee of Scientists (1998), who in draft # 5 of *Sustaining the People's Lands: Recommendations for Stewardship of the National Forests and Grasslands into the Next Century* stated:

> *In the past, management guidelines for biodiversity have focused primarily on individual species of plants, fungi, vertebrates, and invertebrates. The species-by-species approach to assessing biodiversity is impractical to implement, however, simply because there are so many species. A broader, ecological approach is more cost-effective both in terms of time and finances.*

While realizing that a coarse filter approach may be the only practical way to implement a strategy of managing for biodiversity, the Committee of Scientists warned that habitat alone cannot be used to predict wildlife populations. DNRC recognized this problem and, in developing a management strategy, decided to employ a *fine filter* approach for threatened, endangered, and sensitive species. The fine filter approach focuses on a single species' habitat requirements.

Appropriate Conditions

After we agreed on a management philosophy under the SFLMP, the next step was to develop a procedure by which we could implement such a biodiversity management strategy. The process by which we manage for the appropriate mix of stand structures and compositions (appropriate or desired future conditions) on state lands is outlined in the SFLMP Biodiversity Implementation Guidance. To determine appropriate conditions, a set of filters was developed to use on our Stand Level Inventory (SLI). As a first step, this procedure looks at current species representation or "the mix of species present on a site" to determine what would be an appropriate condition in terms of cover-type representation across an entire DNRC management unit (e.g., the Swan Unit). Emphasis is given to shade-intolerant species since they are the ones whose representation on the landscape has been substantially reduced through our activities, fire suppression, timber harvesting, introduced diseases, etc. Stands are evaluated against the criteria in Table 1, beginning with white pine and proceeding down the Cover Type column. Once assigned, a stand is not evaluated against other cover-type criteria. This procedure is referred to as the Appropriate Conditions Filter. For example, if our SLI shows that a stand is currently composed of $\geq$ 10 percent of white pine, then the stand is categorized as an appropriate white pine stand. A subsequent stand may have $<$ 10 percent white pine and $\geq$ 20 percent ponderosa pine in its current composition. This stand would be categorized as an appropriate ponderosa pine stand. This procedure is applied to all stands on a unit, until all stands have been categorized into their appropriate conditions. There is no supposition that this filter is the end-all, be-all indicator of appropriate conditions. Rather it represents a methodology, founded in succession theory, that we use for a first approximation of appropriate cover type representation. Additionally, knowledge of particular stands by local unit foresters and inventory specialists is used to adjust the Appropriate Conditions Filter.

The Appropriate Conditions Filter gives us an indication of proportions of cover types that would be expected to have occurred on the landscape under natural conditions (i.e., no fire suppression and no past logging). We do not use the Appropriate Conditions Filter output to manage individual stands, but instead we use the information to tell us proportions of cover types to manage toward at the unit level.

Given that the Appropriate Conditions Filter was designed to be used on the SLI. units (particularly on the Eastside) that do not have a SLI still need to ensure that they are meeting our commitment to retain at least half the average proportion of old growth that would be expected to occur with natural processes on similar sites. As part of field reconnaissance, foresters need to gather data on current cover types and ages of stands within the project area. Current cover types should be assigned using criteria in the Biodiversity Guidance (Current Conditions Filter 2). Units still need to compare current conditions of old growth by cover type to Losensky's (1997) estimates of old growth in the 1930s, and ensure that they are keeping at least half of the old growth that Losensky estimated to occur by cover type for their particular climatic section. This analysis may be done at the project level since the lack of SLI data precludes analysis at the unit level.

Old Growth Commitments from SFLMP

Part of our biodiversity management strategy includes managing for old-growth forests. SFLMP states that DNRC would "seek to maintain or restore old-growth forest in amounts of at least half the average proportion that would be expected to occur with natural processes on similar sites" (MT DNRC 1996). Old growth must be retained, not only in the amounts committed to, but in appropriate proportions and sites across the landscape. This makes it important to define the proportions of particular forest types that would be expected to develop within particular landscapes, rather than the much easier, but unsustainable, approach of managing simply for what is there now.

In SFLMP, DNRC conceptually defined old growth as:

> *Forest areas that are in the later stages of stand development. Old-growth forests are generally dominated by relatively large old trees, contain wide variation in tree sizes, exhibit some degree of multi-storied structure, have signs of decadence such as rot and spike-topped trees, and contain standing snags and large down logs. Specific criteria for identifying old growth vary by environment and forest type.*

To assure that we are meeting our SFLMP commitments, DNRC has adopted a working definition of old growth. We currently define old growth as:

> *Stands that are 150 years and older (140 years for lodgepole pine) that exhibit a range of structural attributes associated with old age, and contain a minimum of 4 Mbf per acre, net.*

Although DNRC has chosen the above working definition, we recognize that, when defining old-growth minimums for

Table 1. Protocol for Assigning Appropriate Conditions by Cover Types

Cover Type*	Proportional Representation (Percentage) of Species in Each Cover Type				
	Ponderosa Pine	**Douglas-fir**	**Western Larch**	**Western White Pine**	**Lodgepole Pine**
Western white pine				≥10	
Ponderosa pine	≥20				
Western larch/Douglas-fir		Western larch/Douglas-fir ≥30 (western larch present)			
Douglas-fir		≥50			
Lodgepole pine					≥40
Mixed conifer	Habitat type <630 and stands not yet assigned				
Subalpine types	All remaining stands				

* Types were assigned in the order listed. Once assigned, a stand was not subjected to subsequent assignment criteria.

state-owned forested lands, several complications must be addressed. A restrictive old-growth definition that is acceptable to all, or even most, resource professionals does not exist. The components important in one type of old growth may not be present or important in another type; thus, a restrictive definition of old growth for one forest type is unlikely to be applicable to another forest type. Finally, no quantification of a restrictively defined, naturally occurring amount of old growth exists. The DNRC approaches the old-growth issue from the perspective that characteristics of old-growth stands that make them functionally different from other stands should be defined and managed for. In an effort to define and manage for the characteristics or attributes of old-growth stands, the Old-Growth Working Group is currently designing several old-growth matrices that would categorize amounts of old-growth attributes. The matrices would also define a distribution of attribute levels, in the form of an old-growth index, that would need to be represented within certain old-growth forest types.

Although no estimates of historical amounts of old growth are available, there are estimates of historical age-class distributions and accompanying estimates of proportions of old stands. This information is available from a forest inventory conducted in the 1930s across western Montana. Losensky (1997) summarized the 1930s' inventories showing proportional age-class distributions by climatic section.

> *The proportion of old-growth stands by cover type within a given analysis area, compared to the climatic section proportion of old stands from the 1930s' inventory, is DNRC's numeric criterion for assessing compliance with our commitment to retaining a minimum of 50 percent of old-growth amounts that would be expected to occur with natural processes on similar sites.*

DNRC must assess the SFLMP commitment based on old stands (Losensky 1997), but DNRC is not suggesting that *old-growth attributes* would be ignored. Along with our generic old-growth definition, DNRC will assess the structural attributes associated with old age that characterize the variety of old-growth forest conditions that would have naturally occurred on the landscape. Old-growth stands that have high levels of old-growth attributes and stands that do not should both be included in DNRC's retention of old-growth stands, because DNRC is comparing current old-growth proportions to a historical assessment that included both types of stands. This degree-of-old-growthedness approach ensures that we will be keeping all the pieces of both the ecosystem and old-growth "pies" that could and should exist on the land we manage.

A key assumption is that retaining one-half of old stands gives us the assurance we are keeping the range of conditions that should exist. This is consistent with our coarse filter approach to biodiversity. We believe that both types of old stands (i.e., old but not decadent, and old and decadent) are necessary to develop and retain the various characteristics of stands that may be important, but undefined. The intent of SFLMP is to maintain enough old growth to meet the specified old-growth commitment, and to not drop below that amount. The "at-least-half" amount represents the minimum DNRC has committed to retaining, but does not necessarily represent the maximum desirable for retention.

Calculating Old-Growth Minimums

The minimum proportions of old-growth stands to be retained, by cover type, are calculated by multiplying the appropriate proportion of cover types at the unit level (output from the Appropriate Conditions filter) by one-half the proportion of each cover type that existed in the 1930s' inventory as old stands at the climatic section level. The product is then multiplied by the forested acres on the unit to indicate the minimum acres of old-growth stands to maintain by cover type. For instance, on the Swan River State Forest (SRSF), with 38,604 forested acres, the appropriate proportion of ponderosa pine is 5.33 percent, which equates to about 2,058 acres of ponderosa pine. According to 1930's inventory data, approximately 74 percent of the ponderosa pine in the climatic section that encompasses SRSF was categorized as being old stands (>150 years old). One-half of 74 percent is 37 percent; so, to determine the minimum proportion of old-growth ponderosa pine on SRSF, one would multiply 2,058 acres by 37 percent and arrive at a figure of 761 acres. The minimum number of acres of old-growth ponderosa pine to be managed for on SRSF is 761 acres.

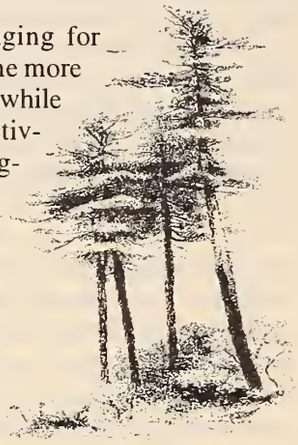
As was alluded to previously, units that do not have a SLI must calculate old-growth minimums using a slightly different procedure. Non-SLI units should calculate minimum acres of old-growth stands to be retained, by cover type, by multiplying the current acres of a cover type at the project level by one-half the proportion of each cover type that existed in the 1930s inventory as old stands at the climatic section level. For example, let's assume that on a section of DNRC ownership within Musselshell Climatic Section (i.e., Lewistown Unit), 70 acres of ponderosa pine exist on a 640-acre section. In order to calculate the old-growth minimum for the ponderosa pine cover type, one would multiply 70 acres by 3.5 percent (one-half the Losensky proportion of ponderosa pine old stands for the Musselshell Climatic Section) for a minimum old-growth retention of 2.5 acres for the project area. Please refer to the Eastside ponderosa pine old growth Draft Guidance dated February 2, 1999, for additional information.

What Does All of This Mean for the Field?

DNRC's shift in its management approach from stand-level management to managing for biodiversity has had profound impacts for the field units. Previously, when field foresters set up timber sales, they were mostly concerned with identifying accessible, high risk, and high value timber, while dealing with constraints due to water and wildlife resources. Now, foresters must also assess current and appropriate conditions of cover types and determine which cover types are over- or underrepresented on the landscape. Next they must manage toward the appropriate or desired future condition by emulating natural disturbances (e.g., fire regimes). Additionally, foresters must determine how much old growth they have on their units, and they need to plan sales that maintain at least half the average proportion of old growth that would be expected to occur on the climatic section(s) (identified by

Losensky 1997) that encompass their unit. They must calculate the minimum proportions of old-growth stands using the aforementioned procedures. Finally, foresters, in conjunction with the wildlife biologists, must assess where old-growth stands should be maintained geographically on each unit. In doing this, foresters must look at patch size, connectivity, adjacent ownership, etc. The Swan Unit (NWLO) has identified an old-growth network, and other units may soon follow suit. (See the article by Ross Baty on the Swan Unit's old-growth network.)

Conclusion



Overall, we believe that managing for biodiversity has helped us become more proactive in our planning efforts, while enhancing the long-term productivity of the trust. DNRC is managing for a desired future condition that is based on succession theory and predicated on maintaining all of the pieces in the ecosystem (old growth, wildlife, water, soils, sensitive plants, etc.) through application of both coarse and fine filters.

SFLMP Implementation Guidance Update

Tom Schultz

Most of the Final SFLMP Implementation Guidance has been distributed to the field. Listed below are the dates that the guidance pertaining to each specific Resource Management Standard (RMS) was issued.

- Big Game – February 17, 1998
- Biodiversity – May 15, 1998
- Fisheries – May 12, 1998
- Grazing on Classified Forest Lands – May 28, 1998
- Road Management – February 17, 1998
- Sensitive Animal Species – February 17, 1998
- Sensitive Plant Species – October 5, 1998
- Sensitive Species Background Guidance – June 26, 1998
- Silviculture (Draft Silvicultural Treatment Standards and Guidelines) – March 1, 1991
- Threatened and Endangered Species – February 17, 1998
- Watershed (2, 7, 12, 17) – May 12, 1998
- Watershed (3, 18, 19, 20) – to be distributed by July 1, 1999
- Weed Management – to be distributed by June 1, 1999

Please review your SFLMP Implementation Binders to be sure that you have the Final Guidance that is listed above. If you are missing any of the guidance, please check with other unit/area personnel and make copies for yourself. If everyone at your unit is missing a copy of the guidance, please call me at 542-4306, and I will get you a copy of what you need. As a note to supervisors, please retrieve copies of the SFLMP Implementation Binders from employees who may be leaving the agency. I have had to make numerous copies of the Implementation Binders for new employees who are unable to locate their predecessors' binders.

Spring Training Update

Pat Flowers

The topics, dates, and location have been determined for the spring training session sponsored by the Forest Management Bureau. This year we will hold the sessions in Helena, at the Park Plaza Hotel. A block of rooms has been reserved for us. State rates apply. Tell the hotel that you are with the DNRC Forest Management group, and make your reservations by May 7. The phone numbers are 406 443-2200 or 800 332-2290.

The sessions will start at 1:00 p.m. on June 7 with a presentation on trust land issues by Jon Souder and a panel discussion. On June 8 we will focus on efficient and effective forest land management. On June 9 we will provide resource updates, discuss old-growth developments, and have a collaborative skills session. On June 10 will be an optional field trip to a CLO timber sale. A more detailed agenda will be sent out as presentations are finalized.

Call Scott McLeod at 542-4269 if you have any questions about the upcoming training.

Forest Improvement: Forest Nutrient Management

Scott McLeod

In 1997 the Forest Improvement Team recommended that whole-tree skidding be carefully examined due to its potential to reduce the availability of nutrients essential to forest productivity through removal of tree crowns and foliage. That recommendation met with both strong support and fervent disagreement. In response to the disagreements I asked the Intermountain Forest Tree Nutrition Cooperative (IFTNC) to prepare a position paper or summary document describing the current state of knowledge regarding forest nutrient management. This article summarizes some of the important findings from the IFTNC paper.

To manage forest nutrients we need to understand how and where they are stored, their function, and the effects of our actions on nutrient availability and presence. Many studies have examined nutrient budgets at the ecosystem level. General statements that can be made include:

- About one-half of the total potassium (K), magnesium (Mg), and exchangeable phosphorus (P) is held in above-ground vegetation.
- Nitrogen and calcium (Ca) appear to be held in equal or greater amounts in soil and organic matter than in the standing crop.
- Of the nutrients held in living, above-ground vegetation, about 85 to 90 percent is held in the branches, twigs, and foliage.

Thus, from a strict nutrient conservation perspective, we should leave as much of the branches, twigs, and foliage on the site as is possible.

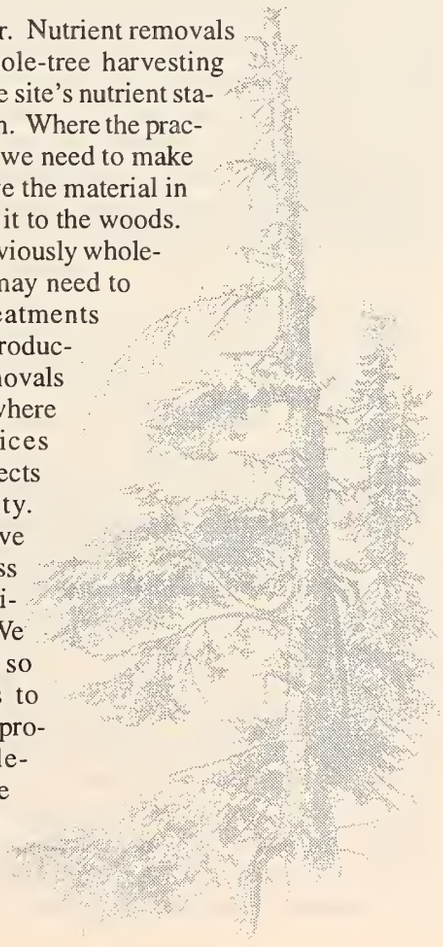
Naturally, there are economic considerations to weigh. Many operators are equipped to conduct whole-tree skidding at economically attractive rates. Are the costs associated with leaving the material in the woods sufficient to pay the additional costs of doing so (if, in fact, additional costs are incurred)? Several studies have examined the effects of conventional and whole tree skidding operations on nutrient reserves. One study conducted in spruce stands in Ontario (Timmer et al. 1982) found that whole-tree harvesting had far greater effects on nutrients than did conventional harvesting, removing more K from the site than remained in soil reserves, post-harvest. Ca, P, and Mg were also greatly affected. Although the biomass removed from the site was 56 to 110 percent greater with whole-tree skidding than with conventional harvesting, the nutrient removals were far greater at 83 to 224 percent. Similar results were found by other researchers (Freedman 1981; Johnson 1983; Mann et al. 1988; Brais et al. 1995; Stevens et al. 1995; Olsson et al. 1996; Knoepp and Swank 1997). These studies provide strong evidence that any harvesting that removes tree crowns from the site will adversely affect nutrient reserves and availability.

Are the nutrient removals associated with whole-tree skidding of consequence to tree growth? There are other studies that have looked at the performance of second-growth stands following various harvest practices. The magnitude of effects varies by harvest method and by site quality. Although more nutrients were removed from the high-quality site, the effects on seedling performance were greater on the low-quality site. Whole-tree harvesting resulted in 20 percent less height growth than did conventional removals (Bigger and Cole 1983). Thus, low-quality sites (most of our land, especially east of the divide) show a greater detrimental effect from whole-tree harvesting than do high-quality sites.

Proe et al. (1996) working with Sitka spruce, found that whole-tree harvesting reduced mean tree volume by 32 percent compared to conventional harvesting (12-year results). They also found that fertilizing improved growth by 13 percent over the growth in conventionally harvested areas that received no fertilizer.

Site preparation can also adversely affect second-rotation performance through nutrient removals, soil compaction, organic material removal, etc. Fire has variable effects depending on fuel loads and intensity, although generally some nitrogen is volatilized and lost. From a nutrient perspective, broadcast burning appears to be preferable to piling and burning.

The message is clear. Nutrient removals associated with whole-tree harvesting are detrimental to the site's nutrient status and to tree growth. Where the practice is unavoidable, we need to make efforts to either leave the material in the woods or return it to the woods. In areas we have previously whole-tree harvested, we may need to apply fertilizer treatments simply to restore productivity. Nutrient removals represent one area where our current practices may have lasting effects on site productivity. We, as an agency, have made major progress in keeping the nutrients in the woods. We know the risks and so can take measures to help ensure that site productivity is not decreased for the sake of convenience.



Development of an Old-Growth Network

Ross Baty

Ahhh, the air smells damp and fresh, the wind is calm, and your surroundings are dark and secure. You stub your toe on a moss-covered rock and lose your balance. You immediately drop your clipboard and realize that you are on your way down, your motions leading toward an irreversible and less than graceful face plant! As you begin the process of collecting the increment borer and clinometer that have fallen from your vest pockets, you notice a decayed Douglas-fir log on the ground in front of you embellished with fruiting bodies of various fungi. As you push the punky log out of your way in disgust and frustration from your fall, you expose a den of small black ants scurrying to move their coveted cache of larvae to a safer retreat. A few feet to the right, a long-toed salamander jarred by the disturbance of the log emerges from underneath a piece of sloughing bark. The salamander slithers to the safety of a nearby mat of rotting leaves, and you regain your vertical posture, reflecting on your forced face-to-face encounter with the rotten log. In doing so you realize that you have just been introduced to several players in a small ecosystem occurring within an old-growth Douglas-fir forest in western Montana.

As most of us are aware, old-growth forests of western Montana provide unique environments for many plants and animals. In the interior Columbia River basin, more than 80 species of birds, mammals, reptiles, and amphibians use attributes associated with old-growth forests, such as live trees with decay, brooms, snags, and downed logs. DNRC recognizes that old growth has unique values, and our commitment to maintain old growth as an important ecological component of timbered landscapes is reflected in the State Forest Land Management Plan, which states:

> *...we would seek to maintain or restore old-growth forest in amounts of at least half the average proportion that would be expected to occur with natural processes on similar sites.*

On the Swan River State Forest (SRSF), harvesting within old forests has become increasingly controversial during the past 20 years due to past land management activities conducted in the Swan Valley. Past harvesting of forested lands on state, corporate, and federal ownerships has resulted in a forested landscape that is currently fragmented. Many remaining patches of old forest on state ownership are relatively small (between 10 and 100 acres). In the past, patches with high amounts of proportional edge were perceived to be beneficial and were often created at the request of wildlife managers wishing to improve habitat for species, such as white-tailed deer, that thrive in high-edge environments. Also, as a result of fire suppression and other human influences, current old-growth amounts are underrepresented in some cover types (e.g., western larch/Douglas-fir) and overrepresented in others (e.g., mixed conifer classification) when average historical levels are considered. Extensive open and closed road systems also occur on SRSF that may influence the connectivity and function of remaining old-growth forest.

In August 1998, Unit Manager Glen Gray requested the assistance of the Forest Management Bureau (FMB) to help develop an old-growth network map that would identify old-growth stands that would best meet DNRC's commitment to retain at least 50 percent of the amounts expected to have occurred on SRSF under average natural processes. Expected benefits of this exercise were to: (1) minimize the potential for haphazard management of existing old-growth stands across the forest, (2) maintain old growth in locations presumed to be most functional in the context of the current landscape, and (3) produce a map that could be used for future project-level planning and identification of special management areas that would promote the maintenance and/or improvement of old-growth conditions on SRSF.

Old-growth maps by cover type for all existing old-growth stands were generated at the FMB Inventory Section using updated stand level inventory information (dated August 1998). Quad-scale, black-and-white aerial photographs were viewed in conjunction with updated quad-scale geographic information system (GIS) maps of old growth to aid in the delineation of stands for inclusion within the old-growth network. Patch size and ample canopy closure (to facilitate connectivity with other similar forests spanning the Swan Valley) were the two primary stand attributes initially used to locate network stands. Stands that were highly isolated from other old growth were typically not included in the old-growth network. A complete listing of considerations that were assumed to promote functional aspects of the network and were incorporated in this mapping exercise includes:

1. High connectivity north to south, and east to west across SRSF (through retention of adjacent patches of similar age with relatively high canopy closure, i.e., >50 percent)
2. High amounts of old-growth core, comprised of large, non-linear patch sizes
3. Low amounts of edge and low complexity of patch shape
4. Close proximity to other core old-growth or mature forest preserves (e.g., adjacent U.S. Forest Service wilderness areas)
5. High diversity in tree species and appropriate cover type across the network
6. Low road densities
7. Stand age >150 years
8. High stand volume (typically >9 Mbf/ac gross volume, from current DNRC SLI data), and high canopy closure (>50% canopy closure, estimated from aerial photography)
9. Maintenance of representative distribution of old growth across range of elevations
10. Retention of old-growth stands along river and stream corridors to facilitate connection within and across drainages
11. Low degree of isolation
12. Maintenance of distribution of core old growth across a variety of aspects

Other considerations that were not specifically addressed as a part of this exercise to date, but were deemed important for future refinements of the SRSF old-growth network, include:

1. High levels of decadence and structural attributes (snags, coarse woody debris, low vigor rating, canopy layers) - to be completed at a later time
2. Consideration of unique conditions or attributes (e.g., unique microsites)

Current opportunities for retaining connectivity across the Swan Valley were inhibited by land ownership patterns, past logging, and road locations on Plum Creek Timber, state, and U.S. Forest Service ownerships. As a result, the greatest opportunities for maintaining connectivity within an old-growth network were found across the northern portion of SRSF, and diagonally (southwest to northeast) across SRSF. "Edges and tails" of some stands were occasionally trimmed to a degree to maintain acreage in the timber base and exclude stand portions currently maintaining high edge-to-core ratios. The wildlife biologist's professional judgment was required in selecting some stands over others.

Younger-aged and mature stands (40 to 149 years of age) that appeared important for maintaining connectivity of forest canopy or for recruiting connectivity between existing old-growth stands, were also identified (labeled "mature stands for connectivity/glue" on maps). The juxtaposition and overstory crown closure of these younger stands were deemed to be more critical for providing connectivity than was age.

Several complications were encountered while developing the old-growth network map. One of the goals at the onset of the mapping exercise was to develop the best map that could be obtained based on the exact acreage of DNRC's commitment to maintain a minimum of 50 percent of historical levels on the Swan River State Forest. An earlier map was produced that displayed what 50 percent retention might look like on SRSF. The 50 percent minimum map showed that the primary considerations of connection and patch size would be substantially compromised. At about 63 percent of the estimated historical amounts, threshold goals for connection and patch size were met.

Our SFLMP biodiversity commitment requires that we seek to maintain or restore old-growth forest in amounts of at least half the average proportion that would be expected to occur with natural processes on similar sites. Our guidance further directs us to maintain sufficient old growth for each cover type on SRSF. At present, SRSF is below the minimum acreage needed for old-growth retention in the western larch/Douglas-fir cover type. To address our SFLMP commitment for this cover type, we identified all existing western larch/Douglas-fir old-growth stands for inclusion in the network. Meeting this commitment took precedence over patch size, connectivity, edge, and isolation considerations throughout the mapping process. This resulted in the retention of some smaller, scattered parcels across SRSF that appear somewhat out-of-place when considering that patch size and connectivity were primary drivers in this effort. Because of this, development of larger, less-fragmented patches should be considered a long-range goal for old-growth stands identified for inclusion in the network within the western larch/Douglas-fir cover type.

The checkerboard-type ownership pattern characteristic of much of SRSF inhibits connection of patches on state ownership. Only two options were feasible for maintaining east-to-west connection across SRSF as dictated by ownership pattern. One of the strategies would attempt to maintain east-to-west connection across the northern portion of the forest across blocked state ownership, and the other strategy would maintain a "diagonal" connection across section corners connecting the northeast portion of SRSF to the southwest corner of SRSF. The diagonal option was selected as the most feasible due to the presence of greater patch sizes and potential for connectivity with remaining old-growth stands. The diagonal distribution also maintained a broader distribution of old growth across the landscape. However, concerns regarding corner-to-corner connectivity across checkerboard ownership remain. Also, the presence of Highway 83 confounds any strategy for old-growth retention that prioritizes east-to-west connection across the Swan Valley.

Is It "Good" for Wildlife?

This map represents compromises to both wildlife habitat and DNRC's available timber base. It provides complete or partial sufficiency in addressing the first twelve considerations previously listed. Maintaining a historically typical range of old-growth amounts, types, and structural representations (i.e., those conditions under which species would have evolved) would presumably be most desirable for native, old-growth-associated wildlife species. Unfortunately, these data do not exist. Our estimate of old growth (100 percent of historical, based on Losensky 1997) that would have been present near the turn of this century is our best estimate of what conditions existed prior to European settlement in Montana. From a wildlife manager's perspective, landscape management strategies that would retain amounts of old growth near 100 percent of historical estimates would generally be desirable for wildlife. However, managing for a 100 percent representation or greater would mean little, if the majority of retained acres were small, isolated patches and were too small to provide usable habitat for target species. Managing for substantially greater historical representation (>100 percent) of late successional forest over time across broad landscapes would likely have adverse consequences for species exhibiting preferences for younger-aged forests. So one might ask the general question, "Is the Swan old-growth network good for wildlife associated with old-growth forest habitat?" My response is yes. The developing draft network clearly does not provide habitat amounts that would be desirable to some individuals who might desire a scenario where 100 percent of the average historical condition is retained . However, this network is a positive step toward retaining important ecological pieces necessary for the maintenance of biological diversity.

Happy snag-watching!

State Land Management Section

Bill Schultz

Timber Sale Program Status

Since July 1, 1998, the beginning of Fiscal Year (FY) 1999, DNRC has sold about 24 million board feet of timber. We have taken sales of approximately 18 million board feet to the State Land Board for approval so far in FY 1999.

Bid openings include Kirby Timber Sale (TS) (338 Mbf) from SLO on December 8, 1998; Middle Bench TS (1,368 Mbf) from NELO on December 21, 1998; Yank Creek TS (394 Mbf) from CLO on January 25, 1999; Adel-Magpie TS (12,280 tons) from NWLO on April 6, 1999; and Aspen Re-offer TS (10,021 tons) from ELO, also on April 6, 1999. Kirby sold for $152.50 per Mbf, Middle Bench sold for $15.03 per ton (± $98 per Mbf), Yank Creek sold for $172.26 per Mbf, Adel-Magpie sold for $26.90/ton, and Aspen Re-offer sold for $15.14/ton. A complaint was filed in district court on the Middle Bench Timber Sale on January 7, 1999. The complaint, filed by the Little Snowies' Coalition, contends that our environmental assessment (EA) is inadequate, asks for an environmental impact statement (EIS), and claims potential conflict with laws protecting migratory birds. Logging has started. A restraining order to halt logging was denied. An injunction hearing was held on February 5, 1999, and the injunction was denied.

The Two Crow TS on the Kalispell Unit was sold in October after, at the request of the State Land Board, we negotiated a conservation license with neighboring landowners. The conservation license resulted in a 15-year deferral of 14 acres and reduced the sale volume by 84 Mbf. The cost to the license holder, Lower Flathead Valley Community Foundation, Inc., is $518 per year. DNRC retained the salvage rights on the 14 acres. The final sale volume was 1,836 Mbf (11,932 tons) from 330 acres.

So far this year, we did not receive any bids on one sale, Blue Bay on the Kalispell Unit. The sale volume was about 1.1 million board feet (7,102 tons) with a minimum of $144/Mbf and a fairly big road package. Prospective purchasers said that the minimum was too high for today's market and the quality and type of wood. We'll hope the market improves and re-offer it.

Selling Timber by the Ton

Many areas have been making a transition to selling some of their timber sales by the ton, rather than by the board foot. A work group was named by the Forest Management Advisory Committee (FMAC) to identify and evaluate options and develop a standard, consistent process for selling by the ton. Work group members are: D. J. Bakken, CLO; Jeff Rupkalvis, SWLO; Jim Wallace, NWLO; Brian Townsend, NELO; and Will Wood, Brian Long, Pat Flowers, and Bill Schultz from the Forest Management Bureau.

The work group's recommendation was presented to the Forest Management Advisory Committee (FMAC) last March, and the work received the committee's approval. Since that time, we have been dealing with the particulars of implementing the recommendation, although it hasn't been the highest priority item on anyone's desk. However, in the near future, FMB plans to complete a "Tons Notebook" for each unit that describes the process and direction for developing and selling a timber sale by the ton. Sections will include:

- Advantages and disadvantages of selling by the ton
- Cruising guidelines when selling by the ton
- Using the INVTRY program on a tons sale
- Conversion factors
- Prospectus and contract
- Accounting program output

In the meantime, if you are planning to sell a timber sale by the ton, please contact Bill Schultz (542-4276) for a contract template and other pertinent information.

DNRC Timber Sales Rate Highest in 1998 BMP Audits

The results of the 1998 statewide best management practices (BMP) audits indicate that DNRC ranks the highest among ownership groups in BMP application and effectiveness. The audits were conducted last summer by interdisciplinary teams that included representatives from government, industry, and the conservation community. The Service Forestry Bureau was responsible for organizing and conducting the audits. Hydrologists Gary Frank and George Mathieus and soil scientist Jeff Collins participated as team members or alternates. These five recently completed DNRC sales were audited: Two Percent in SWLO's Hamilton Unit, Hoodoo in NWLO's Libby Unit, Jeff Med in CLO's Dillon Unit, Belt Park in CLO's Helena Unit, and Cheadle in NELO's Lewistown Unit. The audit teams evaluated a total of 47 sites statewide.

Of the 203 practices rated on the five DNRC timber sales, 96 percent met or exceeded application standards, and 99 percent provided adequate protection. The departures in application were all "minor." Only 1 percent of the practices were rated as having an impact, and those were "minor temporary impact." DNRC also rated highest in the percentage of sites without any impacts and was the only ownership group that had no sites with "major" or "prolonged" impacts.

Great job by all of you! Our commitment to BMP implementation is exemplary.

New to this year's effort was a re-audit of previously audited sites. Three DNRC sites were selected for this review. They were Tom Miner in CLO's Bozeman Unit, Six Mile in SWLO's Missoula Unit, and Dearhorn in NWLO's Plains Unit. In addition, eight sites on other ownerships were re-audited. The results showed that properly installed BMPs remain generally effective for years after installation. For additional information on the 1998 BMP audit results, see George Mathieus's article, "The 1998 Biennial Best Management Practices Audits." For more information on the re-audits and the audit results, check out the 1998 BMP Audit Report available now from the Service Forestry Bureau.

Water Quality Monitoring Program Update

Gary Frank

It was another busy field season for the soil and water boys on staff here at the Forest Management Bureau. Besides doing the usual timber sale environmental assessments and site reviews, we were out in the field "taking a first attempt" at implementing some of the basic concepts presented in the draft Water Quality Monitoring Program (WQMP) developed under the State Forest Land Management Plan (SFLMP). Final State Land Board review of the draft WQMP is just wrapping up, and we will be finalizing the guidance soon. Many aspects of WQMP have remained consistent between drafts. The portions outlined in this article have been the focus of our early implementation efforts. Special thanks to all of the unit office staff and the NWLO hydrologists for their help and cooperation. Without their assistance, none of the monitoring completed to date would have been possible.

Implementation of the Water Quality Monitoring Program involves satisfying the water-quality-related monitoring requirements of several of the resource management standards (RMS) contained in SFLMP. In developing the monitoring plan, the tasks to be completed were brought together under one guidance document written for Watershed RMS #20. This guidance defined the goals of our monitoring program and outlined the steps that will be taken to meet these goals.

Goal #1 of the monitoring program is to determine the sources of watershed impairment on school trust land and to develop strategies for remedial actions. To accomplish this, we are conducting watershed inventories throughout the state on drainages that are prioritized according to a set of criteria we have established under Watershed RMS #3. Priority is given to those drainages where a sensitive fishery or other sensitive beneficial use is present, streams on the 303(d) list of impaired water bodies, and/or areas with a proposed DNRC project within the watershed. Both unit and area field offices are consulted before the final selection of watersheds to be inventoried. During the inventories, all roads, stream crossings, and reaches of stream channels are surveyed in order to identify existing or potential sources of erosion and sediment delivery to streams or other water resources.

This summer, watershed inventories were completed on seven different watersheds by DNRC forest hydrologists. These included: (1) Elk Creek, (2) Blanchard Creek, (3) Lost Horse Creek, and (4) Lost Prairie Creek, all within the Blackfoot River drainage and on the Clearwater Unit; (5) the Gladstone -Wolf Creek drainages on the Helena Unit; (6) the Woodward Creek drainage on the Swan Unit; and (7) the East Fork of Swift Creek drainage in the Stillwater State Forest. The information collected from these inventories will be compiled and entered into a database later this winter. I am currently working with Tom Schultz on creating a database structure that will help make sense out of the "wealth" of information collected.

Goal #2 of the monitoring program is to monitor the implementation of best management practices (BMPs) and other mitigation measures. This goal is being accomplished through visual, qualitative evaluations, which determine whether practices are applied correctly during timber harvest activities and whether these practices are effective in protecting soil and water resources. The evaluations are done primarily through contract administration inspection reports and internal BMP audits.

Since July 1, 1998, several hundred timber sale inspection reports have been completed by sale administrators statewide and forwarded to Jane Markland, program assistant in the Forest Management Bureau. She will be compiling this information into a summary report that will track general trends and compliance with applicable standards contained in SFLMP.

Twenty-three internal BMP audits were also completed on ongoing and recently completed DNRC timber sales this past field season. The audits were conducted by hydrologists and the soil scientist from FMB and NWLO. All DNRC field units with an active timber sale program participated in the audits, with the exception of Hamilton Unit. The Two Percent Timber Sale was the only active sale on the Hamilton Unit, and it was already included in the statewide BMP audit efforts coordinated by the Service Forestry Bureau. The information collected during the internal audits will be compiled and summarized in a format similar to that used in the Statewide BMP Audits Reports of the recent past. This task will also be completed later this winter and early spring.

Goal #3 of the monitoring program calls for DNRC to quantitatively determine the effectiveness of BMPs in reducing nonpoint source pollution, and to quantify water quality and selected biological and physical characteristics of representative watersheds. Specific objectives have been developed to address several key issues facing DNRC that are related to this goal. These include:

1. Determine the effectiveness of mitigation measures commonly used in preventing sediment delivery to streams at newly constructed stream and ephemeral draw crossings
2. Maintain baseline and trend monitoring on five sites in the Stillwater State Forest
3. Determine the relative abundance and composition of large woody debris occurring in reference streams across various channel types and different riparian communities types
4. Determine the effectiveness of streamside management zone (SMZ) harvest prescriptions and tree retention in providing adequate levels of large woody debris in fish-bearing streams or maintaining adequate levels of shade necessary to maintain pre-harvest stream temperature regimes
5. Evaluate the effectiveness of riparian restoration projects in improving in-channel habitat and health of riparian communities

Several site-specific monitoring projects that address these specific goals have been developed and implemented over the last year. These include:

1. Monitoring of sediment delivery downslope of temporary road construction and crossings of several ephemeral draws within the Quiet Stems Timber Sale on the Clearwater Unit
2. Surveys of stream channels, large woody debris, and riparian stands in Chicken Creek and Chepat Creek in the Stillwater State Forest to document characteristics and conditions of reference streams representing undeveloped conditions
3. Monitoring of riparian vegetation and streambank stability to document the effectiveness of a recently completed riparian restoration project in Blanchard Creek on the Clearwater Unit
4. Monitoring of riparian vegetation and streambank disturbance following changes in grazing management on several state parcels in Praine and Andrews creeks on the Hamilton Unit, and the Little Thompson River on the Plains Unit

This upcoming field season we will be busy following up on several ongoing monitoring projects as well as increasing our watershed monitoring efforts. The actual targets for implementation will depend on the amount of final funding the program receives from this current legislative session. Early indications are good, and we are hopeful that the program will be funded at the level requested. If and when additional funding is actually realized, we will start to phase in a fairly large and ambitious monitoring program that will involve quite a bit of contracting.

We will be consulting with both unit and land office staff once we start to put together a short list of potential projects and candidates. Some projects being considered include:

1. Watershed inventories of West Fork Swift Creek, Whitetail Creek, and Porcupine Creek in the Swan Unit; Lyons Creek in the Helena Unit; Alaska Basin in the Dillon Unit; Lyman Creek in the Hamilton Unit, and Bear Creek/Beaver Creek in the Anaconda Unit
2. Collection of macroinvertebrate information for reference reaches established on Chicken Creek and Chepat Creek
3. Establishment of two additional reference reaches on school trust lands
4. Establishment of cooperative fisheries monitoring projects with the Department of Fish, Wildlife and Parks in the SWLO and CLO areas.

We are also interested in setting up temperature and large woody debris monitoring on several reaches of a stream with a harvest proposed immediately adjacent to it. If any of you project leaders are planning any harvest units that might be good candidates for this type of a monitoring project, please contact me.

Regardless of funding levels, the hydrology and soils staff are committed to completing a minimum of five new watershed inventories and 25 internal BMP audits next field season.

So, many of you are probably wondering, "What are we going to do with all of this information or data besides fill up one of my file cabinets?" We have thought ahead on this one and already have conceptualized a feedback process in which the results of monitoring will be incorporated into management decisions (see Monitoring Feedback Loop in Watershed RMS #20 Guidance). Under this process, problem areas are first identified and evaluated on the ground through the monitoring efforts. Next, the monitoring results are evaluated to determine the existence and extent of impacts, the appropriateness of the BMPs selected, whether the BMPs were properly applied in the appropriate locations, and whether properly applied BMPs are effective.

The results of the watershed inventories are used to identify sources of watershed impairment on school trust lands. This information will be used to develop strategies for remedial action and to prioritize watershed improvement projects. In many cases, watershed inventories will be incorporated into timber sale project analyses, and remedies will be incorporated into the timber sale contracts. Other watershed improvement projects will be carried out as funding allows.

Monitoring results may show that a BMP or set of BMPs is not being properly applied or not being applied in the appropriate locations. In the case of ongoing operations, this information may be used as a basis to improve, modify, or suspend a practice through operator education or changes in the contract. If chronic or recurring problems are identified, we will use this information to develop educational or training issues. Educational needs will be used to develop topics addressed though our annual BMP field training sessions. If a BMP is determined to be ineffective, we will evaluate what modifica-

tions are necessary to improve it, or propose development of new BMPs to address the problem.

Reference reaches will be used as control sites, and the information collected will be used in connection with other monitoring efforts. The reference reach will represent a relatively undisturbed condition and form a basis of comparison to detect future treatment effects or effects at another, comparable site.

Monitoring results might also indicate that some of the practices specified in the guidance or resource management standards in SFLMP are ineffective. In this case, the Forest Management Bureau would either revise the guidance or determine whether there is sufficient information or accepted procedures to support adding or modifying a resource management standard.

In the tradition of the hydrologist contributing to this newsletter before me, I will leave you with a quote. Remember always, "Field data are the best cure for a precarious prediction."

The 1998 Biennial Best Management Practices Audits

George Mathieus

The best management practices (BMP) audit process, which the U. S. Environmental Protection Agency (EPA) calls *BMP implementation monitoring*, is a surrogate for water quality monitoring, a more quantitative approach. This biennial audit process, which has occurred since 1990, is used to evaluate whether BMPs are being applied and whether they are effectively limiting nonpoint source pollution.

The 1998 audit process brought some minor changes in both team composition and assessment methods. Traditionally, three audit teams each composed of six members evaluated recently harvested logging operations that met specific high-risk criteria. This round of audits added a new team member, who represented nonindustrial private landowners and/or loggers, to each team. In addition to the evaluation of recent harvest activities, 11 past audit sites were re-audited to document the effectiveness of BMPs over the long term. To handle this increased workload, a fourth team was created from a pool of past audit team members and alternates.

The audit teams evaluated 47 sites for BMP application. Audit results showed that 94 percent of the time BMPs were properly applied. Most harvest sites had at least one instance where BMP application was inadequate; however, the majority of these departures were minor and did not cause erosion or deliver material to a stream. Seventeen percent of the sites had one or more BMP departures that resulted in erosion or deposition of material into a stream. The application of eight high risk BMPs was evaluated separately because they are among those most important to protecting soil and water resources. Eighty-four percent of these high risk BMPs were properly applied.

The audit teams also evaluated BMP effectiveness. Audit results showed that 96 percent of the practices rated were effective in protecting soil and water resources. Most of the sites had some minor departures in BMP effectiveness. Minor departures in effectiveness produce minor impacts to soil and water resources. Seventeen percent of the sites had major departures in BMP effectiveness. Eighty-nine percent of the eight high-risk BMPs evaluated were rated as providing adequate protection to soil and water resources.

The evaluation of "re-audits" concluded the following.

1. The Montana Streamside Management Zone (SMZ) Law and rules appear to be effective in preserving stream condition and function to the same degree as when the areas were originally harvested.
2. Hillslope erosion within harvest units was not evident.
3. Revegetation of harvested areas, skid trails, and landings plays a major role in long-term erosion control.
4. There was no observed delivery of sediment to streams from the harvest units.
5. BMPs are effective over time when properly designed and implemented.

On a more general note, it was pointed out that road surface drainage features should be addressed on a site-specific basis and designed to withstand long-term hydrologic and climatologic events.

The audit teams also evaluated application and implementation of the SMZ law. There were 15 SMZ infractions noted during the audits. Most of these were minor and produced no discernable impacts to soil and water resources.

On an internal note, in 1998 DNRC again scored the highest in application, meeting or exceeding 96 percent of all practices rated and 90 percent of the high-risk BMPs. In addition, sites on state-owned lands rated for effectiveness provided adequate protection 99 percent of the time for all practices and 100 percent of the time for high-risk BMPs. DNRC also had only one site with two SMZ departures, which did not result in impacts to water resources. Once again, these numbers reflect the hard work and commitment provided by our dedicated staff. Congratulations, and keep up the good work!

Economics

Will Wood

Stumpage prices are down from last year, and the numbers of bidders on Westside timber sales are down.

The current stumpage market, however, appears to be stable. The current level of national building has not had an upward effect on DNRC stumpage prices as of yet. Based on an article published in *The Wall Street Journal* (Ewing 1999), the lumber-future market is hot. The relatively small, thinly traded market has gone from a low of around $225 per Mbf this fall to more than $350 per Mbf as of January 1999. Factors that Ewing (1999) cited for this increase include:

- Reduced lumber flows from Canada due to government-imposed quotas on Canadian exports to the U.S. (full shipments from Canada can start again in April)
- Heavier-than-normal pace of construction during the winter months
- A tightness in the availability of new homes

These factors may or may not lead to higher stumpage prices for DNRC in the months to come. We are part of a global economy. The stumpage market may not turn around until the Asian economies turn around. Because of the Asian financial problems, there has been a shift in wood flows; logs/lumber that have previously gone from North America to Japan are staying in North America. The short-term outlook (over the next year or so) is uncertain.

It is important, when planning timber projects at the project level, that we think up front about the estimated stumpage price and the return to the timber program from a proposed timber sale. While some of the factors that affect the stumpage price are out of our control, we do control some of the factors. The major factors that DNRC can control are: logging systems mix (i.e., varying the proportion done by tractor, skyline, and helicopter), road development, road maintenance, forest improvement, access, product mix (peeler versus studs, species mix), average DBH, harvest volume per acre, contract length, and other costs, such as monitoring.

Tables 2, 3, and 4 display the estimated stumpage rate and revenue-to-cost ratio based on different logging system mixes and delivered log values. Table 5 shows estimated delivered log values for a couple of different combinations of species and product mixes. Here are the assumptions.

1. The residual value method was used to estimate the stumpage value ($/Mbf). Logging costs, hauling cost, development cost, forest improvement (FI), and an estimate for profit and risk were subtracted from three different delivered log values. The estimate for profit and risk is a debatable number. For this analysis a value of 10 percent of the delivered log value was used.
2. Three sets of delivered log prices were considered: $450, $375, and $300.
3. The estimated logging costs by system used are: tractor = $106 per Mbf, skyline = $159 per Mbf, and helicopter = $309 per Mbf.
4. The following costs were held constant: haul costs of $30 per Mbf, FI fee of $40 per Mbf, and development costs of $25 per Mbf.
5. The following delivered log prices by species and product were used to demonstrate the impacts of species and product mixes on the average delivered log values: grand fir/subalpine fir = $310 per Mbf, spruce/lodgepole pine = $430 per Mbf, Western larch/Douglas-fir sawtimber = $325 per Mbf, and Western larch/Douglas-fir veneer logs = $470 per Mbf.
6. The cost/Mbf is a statewide average of the last three years based on an estimate of the total cost including FI divided by (the timber sale volume sold plus permit volume).
7. Revenue equals FI fee plus trust income (stumpage).

Table 2
A Comparison of Alternatives with Different Logging System Mixes and a Delivered Log Price of $450 per Mbf

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Logging Cost ($/Mbf)
	(Percentage of Volume by Logging System)				
Tractor	70	50	30	0	106
Skyline	30	30	20	30	159
Helicopter	0	20	50	70	309
Delivered log prices ($/Mbf)	450	450	450	450	
Logging costs ($/Mbf)	122	163	218	264	
Haul cost ($/Mbf)	30	30	30	30	
FI fee ($/Mbf)	40	40	40	40	
Development cost ($/Mbf)	25	25	25	25	
Profit and risk	45	45	45	45	
Trust income ($/Mbf)	188	147	92	46	
Cost ($/Mbf sold)	102	102	102	102	
Revenue/cost ratio	2.24	1.84	1.29	0.84	
FI + dev as % of FI + development + trust income	26%	31%	41%	59%	

Table 3
A Comparison of Alternatives with Different Logging System Mixes and a Delivered Log Price of $375 per Mbf

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Logging Cost ($/Mbf)
	(Percentage of Volume by Logging System)				
Tractor	70	50	30	0	106
Skyline	30	30	20	30	159
Helicopter	0	20	50	70	309
Delivered log prices ($/Mbf)	375	375	375	375	
Logging costs ($/Mbf)	122	163	218	264	
Haul cost ($/Mbf)	30	30	30	30	
FI fee ($/Mbf)	40	40	40	40	
Development cost ($/Mbf)	25	25	25	25	
Profit and risk	38	38	38	38	
Trust income($/Mbf)	120	79	24	-22	
Cost ($/Mbf sold)	102	102	102	102	
Revenue/cost ratio	1.57	1.18	0.63	0.18	
FI + dev as % of FI + development + trust income	35%	45%	73%	149%	

Table 4
A Comparison of Alternatives with Different Logging System Mixes and a Delivered Log Price of $300 per Mbf

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Logging Cost ($/Mbf)
	(Percentage of Volume by Logging System)				
Tractor	70	50	30	0	106
Skyline	30	30	20	30	159
Helicopter	0	20	50	70	309
Del. log prices ($/Mbf)	300	300	300	300	
Logging costs ($/Mbf)	122	163	218	264	
Haul cost ($/Mbf)	30	30	30	30	
FI fee ($/Mbf)	40	40	40	40	
Development cost ($/Mbf)	25	25	25	25	
Profit and risk	30	30	30	30	
Trust income ($/Mbf)	53	13	-43	-89	
Cost ($/Mbf sold)	102	102	102	102	
Revenue/cost ratio	0.91	0.51	-0.03	-0.48	
FI + dev as % of FI + development + trust income	55%	84%	297%	-271%	

Table 5
Scenarios for Species and Product Mix

	Delivered ($/Mbf)	#1 (% Volume)	#2 (% Volume)	#3 (% Volume)	#4 (% Volume)
Grand fir/subalpine fir	$ 310	90%	50%	50%	20%
Spruce/lodgepole pine	$ 430	10%	30%	20%	40%
Western larch/Douglas–fir					
Sawtimber	$ 325	0%	20%	20%	20%
Veneer logs	$ 470	0%	0%	10%	20%
Average delivered log value ($/Mbf)		$ 322	$ 349	$ 353	$ 393

Conclusions

When developing an initial proposal, think up front about the logging system costs, species mix, and product mix, as well as development costs. If the only option is a high-cost logging system with low value species, it may be appropriate to drop the project and go somewhere else. Decreasing the average development cost per Mbf is another option. Consider expanding the project area or increasing the volume harvested in the project. Another option is to do only the road development activities that are required to bring roads up to BMPs. Delay the work that improves the road system for safety concerns (use closures to reduce the risks associated with logging traffic). At the land office level, be concerned about the amount of high-cost systems, species, and product values across all the units.

Forest Inventory Update

Brian Long

Stand Level Inventory (SLI) – Current Status

SLI Contract. Big Sky Resource Analysts of Kalispell completed SLI data collection for all of the NWLO and SWLO except one section in Anaconda Unit. The contractor has not been able to get permission to cross private land from the landowner controlling access to our section. We plan to help the contractor try to gain access to this section in the spring. SLI data have been collected by Big Sky Resource Analysts over the last two field seasons on a total of 89,666 acres in the following units:

- Clearwater Unit – 16,525 acres
- Kalispell Unit – 22,120 acres
- Anaconda Unit – 43,011 acres
- Stillwater Unit – 8,010 acres

Also, eight parcels (4,640 acres) remain to be inventoried this spring in the NELO. Stand boundaries have been delineated on aerial photos by the contractor, and that work has been approved by us for these parcels. The contractor used the new SLI procedure, so there will be information about old-growth attributes in the data collected. We have been pleased with the contractor's work and cooperative attitude during this project.

Swan River State Forest. We completed stand level inventory data collection, mapping, area calculations, data entry, and data editing for 18,700 acres and nearly 500 individual stands of potential old growth in the Swan River State Forest this summer. This work was completed mostly with DNRC employees. Express Services was used to hire a data entry person and Dan Hall to help collect field data. The results of this effort can be seen in the analysis of the proposed timber sale presented in the *South Fork Lost Creek Supplemental EIS.*

Libby Unit. We finished updating the SLI for the Libby Unit this field season. The updating concentrated on areas logged since the last inventory, seedling/sapling stands, pole-timber stands, and potential old-growth stands. We estimate that at least half of the forest acreage in the unit was updated. The new SLI procedure was used in the Libby Unit.

SLI – What's Next

Map Drawing/Area Calculations/Data Entry. We now have the challenge of getting over 110,000 acres of SLI data and stand boundaries drawn on aerial photos (4,000 to 5,000 polygons), processed, and sent out to the respective field offices. We are going to put all available resources into this effort, but it still could take more than a year to complete this work.

More SLI Updating. We will begin updating the Plains Unit using DNRC resources this coming field season. We will contract to have the Stillwater State Forest reinventoried using the new SLI procedures. Fieldwork will probably begin sometime in late July. Data collection will be completed in November 2000.

Digitizing for GIS. During the next fiscal year, we will let contracts to digitize SLI stand boundaries for the Missoula, Libby, and Kalispell Units. The work should be completed in FY 2000. Completing all three units in FY 2000 will depend on how well we estimated the digitizing costs.

Photo Interpretation (PI) Contract

Northwest Management, Inc., of Moscow, Idaho, contracted with us to complete a photo-interpreted forest inventory for 666,000 acres selected from the CLO, NELO, SLO, and ELO. The contractor is a little behind in its work due to several factors. The primary problem was our inability to review its work in a timely manner. This was mostly due to our involvement with the Swan River State Forest stand inventory work. We have made some allowance for that, and the contractor has been very cooperative as well. The photo-interpretation phase is 95 percent complete for the CLO. That's almost 216,000 acres. The contractor has also begun to draw 1:24,000-scale maps of each parcel on Mylar. This contract requires the contractor to draw the stand maps and do the data entry. All work is scheduled to be completed by the end of December 1999.

SLI Training/Orientation

This fall we spent a day in the field with interested persons from the NWLO going over our SLI procedures. We were requested to do this training for the following reasons:

- Help the people who are using SLI data better understand what information is available to them in their SLI database
- Answer questions about how some of the data were collected and how other data were estimated
- Improve their ability to understand what is being done in the Biodiversity Guidance
- Improve their ability to use SLI information
- Improve the field forester's ability to provide us with new SLI information when we implement the annual SLI updating process

We expect to do a similar training session for the SWLO and provide a more intensive SLI training session, to a small group of NWLO foresters, before the end of this fiscal year.

GIS Contracting Update

Inventory currently has two contracts let for acquisition of data for the GIS. One contract is for a statewide ownership map that includes the public land survey system data (or township-range-section lines) at 1:100,000 scale. This map is based on the BLM-generated ownership map with some updating of DNRC-managed lands. Currently the BLM map coverage includes only general State of Montana ownership with no designation of specific management agencies. We have contracted to have the state ownership split into two parts: that which is managed by DNRC, and other state-owned land. We have also contracted to add DNRC parcels that were not on the original map due to a 40-acre minimum polygon size. This will result in the most correct mapping of DNRC-managed land statewide that currently exists. However, this is not to say that all owner designations will be correct on this map. That is beyond the scope of this contract. As part of the ongoing DNRC GIS effort, those ownership areas that are incorrect on this map will be corrected on a project-by-project basis. This contract must be completed statewide by June 12, 1999.

The second contract that is currently let is for acquisition of base data for the Northwest Land Office and the Southwest Land Office. This is the initial step for allowing those land offices to have full GIS coverage for analysis. These maps will be produced with data that are correct at 1:24,000 (or U.S. Geological Survey quad) scale. Base data for these two land offices include land office boundaries, unit boundaries, public land survey system, roads including status, road closure sites, trails, streams, rivers, lakes, railroads, power lines, and county boundaries. These data are being acquired from the U.S. Forest Service cartographic feature files from the Geomatronics Service Center. The timelines for land office completion are NWLO by December 12, 1998, and SWLO by June 12, 1999. As part of the ongoing DNRC GIS effort, data classification such as road status (open, closed, etc.) and closure locations will be edited on a project-by-project basis. The addition of base data to these land office maps does not include Stand Level Inventory stand polygons, which must be added at a later date. When data input is completed for these land offices, the base maps will be distributed digitally for use by those unit and land offices that have OASIS capability.

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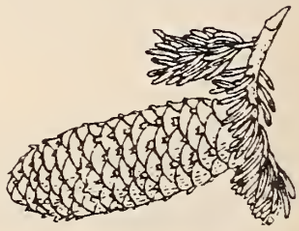

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